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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/753,604	01/08/2004	Steffen F. Schulze	115747-0003//2002P50544US	6349

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EXAMINER

ROSASCO, STEPHEN D

ART UNIT	PAPER NUMBER
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1756

DATE MAILED: 12/08/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/753,604

Applicant(s)

SCHULZE ET AL.

Examiner

Stephen Rosasco

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 October 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-48 is/are pending in the application.
- 4a) Of the above claim(s) 19-28 and 48 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-18 and 29-47 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 08 January 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

Detailed Action

Applicant's election without traverse of Group II (claims 1-18 and 29-47) in the reply filed on 10/17/05 is acknowledged.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-18 and 29-47 are rejected under 35 U.S.C. 102(e) as being anticipated by Imai et al. (5,885,735) or Hanyu et al. (5,561,010) or Komano et al. (5,807,650) or Yang (6,103,430).

There is disclosed a method for repairing a defect in a photolithographic mask for semiconductor patterning, the photolithographic mask having a first layer with a first light transmittance and a second layer having a second light transmittance differing from the first, the second layer being removable in at least one pre-selected region to form a pattern, the second layer, when intact, causing a phase shift in light waves that pass through it relative to light passing through the first layer alone, and, when absent in a region not a subset of the pattern, constituting the defect, the method comprising the steps of: identifying the location of the defect; and introducing a pre-selected phase change at substantially the defect location.

And wherein the step of introducing a pre-selected phase change comprises modifying the thickness of the first layer at substantially the defect location to a pre-selected dimension by either decreasing or increasing this thickness.

The applicant discusses the limitations of the prior art in that with known approaches to the repair of attenuated phase shift masks, which typically employ the deposition of a comparatively opaque carbon-based or other suitable material at the defect site, if the material

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is deposited with care at a particular thickness, it is possible to match the transmittance of the repair material with that of the attenuator. The differing optical properties of the repair material relative to the attenuator generally make it difficult or impossible simultaneously to match the phase of the attenuator.

As a result, although the intensity of light transmitted through the repair region might be properly corrected, the phase is not, and the interference that occurs at the interface between the repair region and those regions that adjoin it will not be destructive interference. The resolution of features in the vicinity of the repair can therefore be expected to be lower than the degree of resolution expected of the photolithographic mask prior to the defect.

There is, therefore, a need for a method of repairing defects in photolithographic masks, such as attenuated phase shift masks, that permits both the transmittance as well as the phase of the light passing through the repair to match those of the light passing through the area of the defect prior to the repair.

(Claims 1-7 and 29-47)

Imai et al. teach a method of manufacturing a mask, comprising: a step of forming a phase shifter with a desired configuration on a substrate which is substantially transparent to exposure light; and

a step of correcting a defect in said phase shifter after said step of forming said phase shifter, wherein said step of correcting the defect in said phase shifter includes a step of removing a desired area of said phase shifter including a defect portion, and a step of forming a transparent film in said area so that the exposure light passed through said phase shifter and the exposure light passed through the area where said transparent film is formed become substantially the same in phase of wave length λ .

And wherein the thickness of said transparent material film falls within a range of $\lambda/(4(n-1))$ to $(3\lambda)/(4(n-1))$ where n represents the refractive index of said transparent material at the wave length λ .

And said step of correcting the defect in said phase shifter includes a step of removing a portion of said phase shifter formed in an area other than a predetermined pattern area by use of a particle beam.

(Claims 8-18 and 29-47)

Hanyu et al. teach a method of correcting defects in a phase shift optical mask, the optical mask comprising a transparent substrate, a phase shifter which shifts a phase of the exposure light by 180 degree with respect to the phase of the exposure light transmitted through the transparent substrate and has a defective portion, and a transparent layer interposed between the transparent substrate and the phase shifter, the transparent layer shifting the phase of the exposure light by 90 degree +180 degree;

(a) removing a portion of the phase shifter which includes the defective portion together with a portion of the transparent layer existing underneath the removed portion of the phase shifter, to form an opening in the phase shifter and the transparent layer; and

(b) forming a new phase shifter portion within the opening from a material which shifts the phase of the exposure light by the same amount as the exposure light transmitted through the phase shifter and the transparent layer.

And wherein the phase shift optical mask further comprises an etching stopper layer which is interposed between the transparent substrate and the transparent layer, said step (a) further comprises: removing the portion of the phase shifter and the portion of the transparent layer to form the opening so that the etching stopper layer is exposed by the opening.

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Komano et al. teach a method of repairing a concave defect existing on a photo mask having a transparent substrate and a mask pattern formed on the substrate, comprising the steps of: irradiating a focused ion beam toward the concave defect, with an accelerated energy less than 10 keV at the surface of the mask; and supplying a deposition gas to the concave defect to form a deposition layer in the defect.

And wherein the photo mask further comprises a phase shifter, which phase shifts at exposure to light.

And wherein the deposition layer is made of the same material as a phase shifter.

Yang teaches a method for repairing at least one bump or divot defect in an integrated circuit processing phase shift template having phase shift areas and non-phase shift areas, the method comprising the steps of: locating the at least one defect in said phase shift template;

coating the phase shift template with resist;

exposing the resist in an area corresponding to the at least one defect and areas adjacent to the at least one defect without exposing other areas;

developing the resist so as to uncover the area corresponding to the at least one defect and areas adjacent to the at least one defect;

subsequently, depositing repair material in the areas uncovered in the developing step, such that the repair material covers the at least one defect; and

subsequently, removing the repair material and material of the at least one defect to a level approximately equal to a non-defect level of a substrate in the areas adjacent to the defect.

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Conclusion

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Stephen Rosasco whose telephone number is (571) 272-1389. The Examiner can normally be reached Monday-Friday, from 8:00 AM to 4:30 PM. The Examiner's supervisor, Mark Huff, can be reached on (571) 272-1385. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'S. Rosasco', with a stylized, elongated initial 'S'.

S. Rosasco
Primary Examiner
Art Unit 1756

S. Rosasco
12/05/05